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INDUSTRIAL WASTES POLLUTION STUDIES AND INVITED TASK

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INDUSTRIAL WASTES POLLUTION STUDIES and INVITED TASK COMMITTEE ASSISTANCE

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Introduction

The program of the Public Health Service of studies of industrial wastes pollution is being carried on under the provisions of the Water Pollution Control Act, Public Law 845, 80th Congress. Throughout the Act, the idea of Federal assistance to the States in carrying out water pollution control activities is stressed. It has long been the policy of the Public Health Service to support and assist State health activities and, in the Water Pollution Control Act, the Congress confirmed this policy by including the provision:

> "It is hereby declared to be the policy of Congress to recognize, preserve, and protect the primary responsibilities of the States in controlling water pollution."

The Act emphasizes also the need for industrial wastes research and authorizes the Surgeon General

> "to support and aid technical research to devise and perfect methods of treatment of industrial wastes which are not susceptible to known effective methods of treatment; make available to State and interstate agencies, municipalities, industries, and individuals the results of surveys, studies, investigations, research and experiments relating to water pollution and the prevention and abatement thereof conducted by the Surgeon General and by authorized cooperating agencies."

The industrial waste research activities undertaken by the Environmental Health Center are in conformity with these provisions of the Act. Their essential purpose is to provide technical data for support of the States' pollution control activities. One other point should be stressed - namely that the "support and aid" of technical research to devise and perfect industrial waste treatment methods means just what it says. The Public Health

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16. Abstracts: Objectives of the industrial wastes program are: (1) to assemble basic information on those industrial wastes having national or regional significance; (2) to determine, in the light of stream uses, the physical, chemical, and biological effects and rates of recovery from effects of industrial wastes in the receiving waters; (3) to develop and improve analytical methods, techniques, and equipment for studying industrial wastes and their effects on receiving waters; and (4) to evaluate control methods and undertake miscellaneous activities. Coordinated efforts are required to achieve these goals. Data on pollution effects and stream recovery are gathered from literature reviews, research laboratory activities, stream surveys, analytical methods, bioassay techniques, and population enumeration methods. Specific areas in which the Technical Task Committee on Industrial Wastes can contribute are outlined.

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Service will extend "support and aid" but this should not be implied as acceptance of responsibility for such development; this responsibility lies with industry. The Task Committee can be of assistance in commenting upon the Public Health Service program in view of this policy.

The Environmental Health Center is staffed and equipped, within budgetary limitations, to conduct industrial waste studies and to investigate stream pollution problems associated therewith. Objectives of the industrial wastes program are four fold:

1. To assemble basic information on those industrial wastes having national or regional significance.

2. To determine, in the light of stream uses, the physical, chemical, and biological effects and rates of recovery from effects of industrial wastes in the receiving waters.

3. To develop and improve analytical methods, techniques, and equipment for studying industrial wastes and their effects on receiving waters.

4. To evaluate control methods and undertake miscellaneous activities.

An effective program requires balanced coordinated effort in achieving these objectives since they are interrelated. For example, basic analytical data can only be obtained properly through use of suitable methods which in many instances must be developed. Conversely, research on analytical methods requires knowledge of the possible presence of interfering substances, the conditions under which the method will be applied, the significance of the determination, and other factors pertinent to the study.

The Environmental Health Center program of industrial wastes studies may be considered under each of the objectives listed above.

Basic Information on Industrial Wastes

The assembly of basic information on industrial wastes are undertaken by the Environmental Health Center primarily to provide technical data to the

States necessary to them in carrying out their water pollution control responsibilities. The availability of such data provides a sound foundation for administrative decisions which will be equitable to the downstream water user and to the waste contributor.

The approach to each project for the assembly of basic information on industrial wastes having national or regional significance follows the same general plan, the program being modified as necessary to conform with requirements of a specific industry. Individual plant surveys are undertaken to determine the total pollution load from an industry and to indicate the significance, quantity, concentration, and characteristics of each major individual waste. Each project and each individual industrial plant survey agreed upon is scheduled through cooperation of the river basin offices and with approval of the state stream control agencies.

Variations in process, equipment, and operation often make impractical the direct comparison of waste data from one plant with those from another. However, ordinarily a comprehensive study of wastes from 3 to 5 selected manufacturing plants, representing a given industry, gives a reasonably complete picture of the waste problems involved.

Literature Review General knowledge of the process is the first step in consideration of an industrial waste. Trade journals covering a specific industry usually contain some information on the process wastes. Review of the technical literature serves as an introduction and aids in appraisal of the problem. It serves also to prevent undesirable duplication of previous work, and gives the worker knowledge of the present status and magnitude of the problem. Pertinent abstracts and reference material from the Task Committee would expedite this literature review and would fill a need in the field.

Field Studies The Environmental Health Center industrial waste field studies are cooperative projects with the river basin offices, the State stream control agencies, and with industry, being conducted at selected manufacturing plants where the results promise to have national or regional significance. The results of these cooperative studies have proved valuable to the management of the particular plant studied in that they constitute factual information essential to mutual understanding between the company and the state stream control agency. Each project contributes additional technical information bearing on the problem. The typical Environmental Health Center field unit staff for such a study is composed of 4 to 7 persons - engineers, chemists, and scientific aides, the size of the crew being dependent on the magnitude of the project and the time allotted to it. When biological work is of value, one or two biologists and aides are included in this field crew. These teams operate from mobile laboratories which are temporarily located at the industrial plant being studied.

Each company designates a technical representative who collaborates in organization, planning, and conduct of the survey, and review of data. The industrial representative is usually from the research department but may be from any department within the company charged with the responsibility of studying the plant wastes. Knowledge of the plant and process is the primary qualification for this industrial technologist.

Since these are cooperative projects industry is expected to contribute by assuming responsibility for:

1. Installation of flow measuring equipment when necessary.
2. Collection of representative samples.
3. Utilities for the mobile laboratory.

Reports The Environmental Health Center prepares a report on each

individual survey and provides the company concerned with copies. These copies are forwarded through the state stream control agency in which the industrial plant studied is located. These reports are not considered official record until they have been reviewed and approved by the company. Reports of the individual plant studies are considered confidential and distribution is restricted to the ccoperating agencies, namely: the company, the state, and the Public Health Service.

Industrial Waste Guides Information obtained from review of the technical literature, field surveys, and special studies will be used in the preparation of Industrial Waste Guides for each major industrial waste. Identification of specific plants is deleted in the Guide, which is intended to represent the conditions that may be expected from industrial wastes for a given industry. These Guides are given unlimited distribution.

The National Technical Task Committee on Industrial Wastes can give invaluable assistance in the preparation of these Guides by furnishing unpublished data which may be pertinent. Likewise this Committee can contribute by critical review of the Guide manuscript or suggesting competent reviewers.

Work leading to preparation of these Guides often brings out the need for research on analytical methods. Such research may continue over extended periods. It is expected that each Industrial Waste Guide will give the analytical methods used in obtaining the Public Health Service field results reported.

Projects Recent projects have included field studies of waste from beet sugar plants, integrated steel mills with emphasis being placed on by-product coke operations, and Kraft pulp manufacture. The work with beet sugar wastes included experimental lime treatment of pulp water and press

liquor in a pilot plant. Chlorination of settled pulp water and its reuse as diffusion battery supply was studied on plant scale.

Selection of future projects will be based on the magnitude of the industrial waste problem, the needs of state stream control agencies and industry, and the opportunity to contribute to stream pollution abatement programs. Suggestions from the Task Committee are invited as a means of establishing priorities and locations where the maximum results can be realized from the effort expended.

Pollution Effects and Stream Recovery

Fundamental in the consideration of water pollution and its correction is a knowledge and understanding of the events and consequences following discharge of polluting substances into receiving waters. The effects are mutual: polluting substances cause chemical, physical and biological changes in the receiving waters; and chemical and physical reactions and biological activity in the receiving waters cause changes in the polluting substances discharged thereinto. Thorough knowledge of these matters, quantitatively, is necessary for the establishment of equitable water quality objectives or water quality requirements.

Studies of pollutional effects and natural purification may cover a short or long period and may be on a laboratory or field scale.

Literature Review Literature reviews are beneficial in approaching this and other problems. A specific literature review is normally conducted at the start of a specific project. As a long term activity, personnel at the Environmental Health Center participate as members of various literature review groups such as Committees of the Federation of Sewage and Industrial Waste Association. This committee work prevents duplication of

effort and aids the over-all program. The Task Committee might consider its participation in similar review activities.

Research Laboratory Activities. The first step in the study of pollution effects and stream recovery is often in the laboratory. The Environmental Health Center has for many years made studies, under carefully controlled conditions, of the factors governing the persistence of important specific constituents of industrial wastes in surface waters. Some of the factors which may be investigated in relation to a particular compound or group of materials are:

1. Susceptibility to biochemical attack under various conditions.

2. Susceptibility to loss by volatilization, chemical transformation, precipitation, or adsorption.

3. In the case of toxic materials, studies to determine the adverse effect of these materials on normal biochemical oxidation rates that occur in polluted water and streams.

An example of this activity is a recent study of dissipation rates for phenols and related compounds. Some years ago a similar study showed that TNT wastes are not assimilated in natural waters to any appreciable degree. Such studies also yield valuable information as to the applicability of biological treatment method to specific wastes.

The bioassay technique, discussed later, can be used to determine toxicity of waste materials under a wide variety of conditions in the laboratory. Information on limiting concentrations of individual waste constituents in waters suitable for fish, and the role of various factors which influence these tolerance limits, result from this activity.

Representatives of the Public Health Service have, for years, served as committee members in the development of the drinking water standards. Infor-

mation on limiting concentrations of constituents in public water supplies result from this activity.

The Task Committee could well support a similar activity with information on limiting concentrations of constituents in industrial water supplies.

Stream Surveys. The Public Health Service has long been active in fundamental studies of the pollutional and natural purification reactions in polluted waters. One of the first of such field studies was started on the Ohio River in 1914. Some of the presently accepted fundamental concepts of stream self purification were developed during this early study. Later studies were made of the Illinois River (1921), the Mississippi River (1926), and the Scioto River (1937). A study of Lytle Creek, a small stream near Cincinnati, is currently under way with stress being placed on biological phases.

A stream survey of a research type should determine stream conditions above, immediately below sources of pollution and downstream through the zone of recovery, if important conclusions on stream damage and self purification are to be reached. The specific items which might be included in such a stream survey are as follows:

1. Studies of physical and chemical factors of importance to all water uses, Dissolved Oxygen, pH, alkalinity, turbidity, temperature, Biochemical Oxygen Demand, toxicity and other factors of special interest.

2. Studies of health hazards.

   a. Toxic effects and undesirable tastes and odors.

   b. Bacteria concentration - Pathogenic organisms - their presence and persistence.

3. Studies of plankton populations - composition, variations, indicator organisms and significance in water supplies.

4. Investigation of bottom fauna -- determination of total numbers and associations of organisms (bacteria, fungi,

worms, crustacea, and insects) to indicate (a) severity and extent of pollution, and (b) severe conditions such as slugs and spills occurring in the past, as indicated by those organisms having long life histories.

5. Studies of fish distribution and population, by seining to determine barren zones and varieties present and population studies to determine qualitative and quantitative changes in the fish populations, and economic losses to sport and commercial fisheries.

6. Toxicity bioassays or fish toxicity studies to locate sources of toxic materials and to determine the amount of treatment, removal or dilution needed to overcome their harmful effects. Toxicity tests (bioassays) can also be used routinely by industry to check on and control their effluents.

Not all stream studies are or need to be of such comprehensive extent. More limited study of specific problems is often made on a short time basis. For example, in connection with the industrial waste surveys which have been mentioned, it is often desirable to make an inventory of conditions in the receiving waters to correlate with the results of the plant survey.

Analytical Methods and Other Techniques

Tools necessary for the study of industrial waste pollution are one concern of the research program under way at the Center. Current and proposed activities in this field include chemical analytical methods research, the development of standard bioassay or toxicity evaluation methods and the development of methods for making population studies of fish in large streams.

Analytical Methods Examples of current activities leading to the improvement and simplification of analytical procedures particularly adapted to the evaluation of industrial wastes in waste waters and streams include:

1. Development of oxygen consumed procedures.

2. A comparative study of a number of recently proposed oxygen consumed methods on typical industrial wastes and a statistical evaluation of the results.

3. The development of methods for the isolation and determination of phenolic materials in low concentrations with emphasis toward the improvement of the sensitivity and specificity of the procedures.

4. Development of methods for the detection of trace quantities of pyridine and certain types of pyridine bases.

5. Participation in the standardization of analytical techniques through committees of the Federation of Sewage and Industrial Associations and the American Society for Testing Materials.

Outstanding technical talent is available in the research staffs and in the laboratories of industrial plants. An activity of the American Society for Testing Materials is serving to utilize some of this talent in the interest of water pollution control through the development of chemical analytical methods. The Task Committee might well aid in supporting or extending this activity.

Bioassay Methods Attention is being devoted to bioassay methods for the evaluation of the toxicity of industrial wastes to aquatic organisms. These methods are essential for the detection of toxic waste compounds, many of which are not readily detectable and measurable by chemical means, and for the evaluation of their varying effect upon aquatic life, when they are present in different combinations and in waters of varying mineral content. Uniformity of bioassay techniques is essential to the comparability of toxicity data and to their increasingly reliable application to the solution of practical waste disposal problems. Coordination of effort directed toward this end is achieved through active participation in the work of an appropriate committee within the Federation of Sewage and Industrial Wastes Associations.

Population Enumeration Methods Knowledge of the number of fish and lower organisms can serve many purposes. A drop in population of sport fish and increase in population of coarse type fish can be a delicate indicator of

pollution. Similar indicators have been and are being developed among the lower organisms. Because of the importance of this study method, attention is being devoted to the development and refinement of methods and apparatus for the sampling and study of populations of aquatic organisms in waters receiving industrial wastes. Studies include the application of the biological data so obtained in the evaluation of over-all pollution effects upon aquatic life of all kinds.

Evaluation of Control Methods and Miscellaneous Activities

The evaluation of control methods is a service which contributes valuable information in assessing the benefits from recovery and treatment systems. One phase of this program pertains to investigation of the effect on process wastes of various systems of equipment operation. Such studies include:

1. Determination of the pollution abatement efficiency of by-product recovery.

2. Evaluation of new waste treatment processes by performance tests on pilot plant and full-scale equipment.

3. Study of combined treatment of industrial wastes and domestic sewage.

For many years sanitary engineers, chemists, biologists, and bacteriologists from the States and municipalities have received training at Cincinnati in particular phases of water pollution control. Consideration might be given to the extension of this activity to provide for seminars with the industrial representative as to technical methods used in water pollution control if a demand for such activity should develop. Consideration of this matter by the Task Committee is suggested.

With increasing emphasis being placed on industrial pollution abatement, there are many special studies which have developed as an outgrowth of this

program. Typical of these studies are:

1. Recovery of the trace quantities of organic material present in water supplies and chemical resolution of such material into its organic constituents by microchemical techniques. (This permits the determination of these organic constituents of industrial wastes which actually reach public water supplies).

2. Study of the fundamental reactions of both industrial waste treatment and stream recovery from industrial wastes.

3. Exploration of the persistence and fate of various pathogenic organisms in industrially polluted waters.

Task Committee Assistance

This discussion has mentioned a number of ways in which the Technical Task Committee on Industrial Wastes can contribute to the organization and development of the Environmental Health Center activities in connection with its part of the industrial waste field study and research program. These are summarized as follows:

1. Comment and advice on Environmental Health Center program as described herein.

2. Literature reviews and preparation of annotated abstracts.

3. Assistance and participation in the preparation of Industrial Waste Guides.

4. Suggestions for E.H.C. program to assist in establishing problem priorities and locations where maximum results can be realized from field studies.

5. Contribution of information on water quality of objectives or requirements.

6. Support of work by industrial research staffs on chemical analytical methods.

7. Suggestions relative to industrial waste seminars.